REMARKS

The applicant appreciates the Examiner's thorough examination of the application and requests reexamination and reconsideration of the application in view of the following remarks.

The Examiner rejects claims 1-19 under 35 U.S.C. §103(a) as being unpatentable over U.S. Patent No. 5,549,003 to *Drescher-Krasicka* in view of U.S. Patent No. 5,286,313 to *Schultz et al.* The Examiner admits that *Drescher-Krasicka* does not teach a detection laser system for projecting a laser beam and intercepting the shear waves at approximately the angle of maximum shear wave propagation and minimizing interference with longitudinal and surface Rayleigh waves. The Examiner refers to the secondary reference *Schultz et al.* for this claimed element.

Schultz et al. teaches as its main purpose determining the temperature of a workpiece within a furnace from the outside. *Schultz et al.* teaches time of flight analysis, or calibrating electrical signals, to ascertain a sensed property of a workpiece such as temperature or physical or metallurgical properties. The former is determined by comparing the workpiece time of flight to known times of flight. The latter is determined by comparing the sensed wave speed to a reference wave speed.

Particularly, *Schultz et al.* teaches measuring time of flight of surface waves between the impulse laser impingement point and the detection laser impingement point to determine the speed of the waves, in order to compare it to look up tables of known values of, i.e., temperature. See, e.g., column 11, lines 17-33; column 21, line 64 through column 22, line 7. Alternatively, *Schultz et al.* teaches measurement of surface displacement of the workpiece attributed to sound waves and correlating them to physical or metallurgical characteristics of the workpiece, or to known wave amplitudes. See column 11, lines 36-41; column 15, lines 36-45.

In the time of flight analysis or the wave speed analysis, where the time of flight or speed is

compared to known values, the distance "X" from the impulse laser impingement point to the detection laser impingement point will be the distance from which time of flight and/or speed is determined, and is thus important to the teachings of *Schultz et al.*, especially in view of the fact that establishing the time it takes for a wave to travel this distance (time-of-flight) and speed (the speed of the wave through the material between these points) is compared to known values. The distance "X" between the impingement point of impulse laser beam 36 and source/detection light beam 47 as taught by *Schultz et al.* is "established as a function of the thickness 'H' of workpiece 23, the intensity of the impulse beam etc. in accordance with conventional and known theory". The "conventional and known theory" referred to by *Schultz et al.* for calculating this distance may be conventional and known theory in accordance with *Schultz et al.*'s teachings, i.e. time of flight analysis or calibrating electrical signals to ascertain a sensed property of the workpiece.

However, *Schultz et al.* does not teach establishing the distance in accordance with the applicant's claimed invention for defect detection, that distance being in accordance with the angle of maximum shear wave propagation and minimizing interference with longitudinal and surface Rayleigh waves, where the shear waves are reflected from the far surface of the sample. The applicant's claimed angle of maximum shear wave propagation and minimum longitudinal surface wave propagation does not appear in *Schultz et al.*'s analysis and *Schultz et al.* otherwise does not teach the applicant's claimed factors in the determination of the distance "X".

Unlike *Schultz et al.* which is concerned that the distance "X" is such that a proper comparison of time of flight and/or speed determined from "X" can be properly made to known values, the applicant's invention appreciates that the angle of maximum propagation for longitudinal waves decreases with increasing angle, while the shear wave has its maximum propagation at an angle which is a function of the spacing between the excitation laser system and the detection laser

system, and the applicant uses this claimed defect detection system to identify the size, location and orientation of a flaw in a sample. See also the applicant's specification at page 9, lines 1-8.

With respect to *Schultz et al.*'s discussion of shear waves, as opposed to surface waves, *Schultz et al.* teaches that the aforementioned correlations can be obtained with shear waves as well as with surface waves. See, e.g., column 4, lines 44-63. At column 22, lines 12-34, *Schultz et al.* teaches that bulk temperature and surface temperature can be obtained simultaneously, where it states in pertinent part at lines 28-34:

> Thus it is possible to simultaneously measure both the bulk temperature of the workpiece through longitudinal and/or shear wave time of flight analysis and also the surface temperature of the workpiece through analysis of the Rayleigh or surface wave time of flight movement as by a laser/interferometer arrangement illustrated in Fig. 2B.

Notably, in this embodiment, *Schultz et al.* is using shear waves, longitudinal waves <u>and</u> surface waves to determine properties of the workpiece. The applicant uses shear waves to determine flaws in a sample, with the detection laser system spaced from said excitation laser for projecting a laser beam and to intercept shear waves reflected from the far surface of the sample at approximately the angle of maximum shear wave propagation and minimize interference with longitudinal and surface Rayleigh waves.

As the applicant sets forth in the specification, the angle of maximum propagation of longitudinal waves decreases with increasing angle. The shear wave has its maximum propagation at an angle where longitudinal wave propagation is decreasing. In the applicant's claimed invention, the angle of maximum shear wave propagation also minimizes surface and longitudinal waves. This angle will vary depending on several variables including the sample material, whether the surface is wet or dry, and the shape of the sample. Nonetheless, the applicant recognized this relationship, took advantage of it, and derived mathematical formulas in that connection. The

applicant discloses various formulas for calculating the claimed angle of maximum propagation. See, e.g., the application at page 9, line 1 through page 10, line 8.

In summary, in contrast to the applicant's independent claims 1 and 12, *Schultz et al.* does not teach or suggest, *inter alia*:

> ... a detection laser system spaced from said excitation laser for projecting a laser beam and to intercept shear waves reflected from the far surface of the sample at approximately the angle of maximum shear wave propagation and minimize interference with longitudinal and surface Rayleigh waves ... [applicant's independent claim 1]
>
> or
>
> ...photoacoustically detecting acoustic waves with a detection laser beam at a second point spaced from the excitation first point for intercepting shear waves reflected from the far surface of the sample at approximately the angle of maximum shear wave propagation and minimizing interference with longitudinal and surface Rayleigh waves ... [applicant's independent claim 12]

Accordingly, neither *Drescher-Krasicka* nor *Schultz et al.* nor their combination disclose, teach or suggest intercepting shear waves reflected from the far surface of the sample at approximately the angle of maximum shear wave propagation and minimizing surface and longitudinal waves.

CONCLUSION

Accordingly, independent claim 1, and claims 2-11 that depend directly or indirectly from claim 1, are in condition for allowance. Additionally, independent claim 12, and claims 13-19 that depend directly or indirectly from claim 12, are also in condition for allowance.

Each of the Examiner's rejections has been addressed or traversed. It is respectfully submitted that the application is in condition for allowance. Early and favorable action is

respectfully requested.

If for any reason this Response is found to be incomplete, or if at any time it appears that a telephone conference with counsel would help advance prosecution, please telephone the undersigned or his associates, collect in Waltham, Massachusetts at (781) 890-5678.

Respectfully submitted,

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TET/ok